

8.0 Proposed Advisory Circular

8.1 Introduction

The following AC has been reviewed by the FAA. This review included legal, technical content and economic considerations. The technical content has been reviewed by both Aircraft Certification and Flight Standards offices. Comments from all FAA reviews have been incorporated into the text of the AC.

8.2 Advisory Circular Viewpoint

The viewpoint of this AC is from the aspect that all necessary OEM documentation needed to accomplish the rule has been approved and issued. This viewpoint will exist at the time of rule codification but does not exist at the writing of this report. The goal is to complete the necessary SRM updates and model specific documents within one year of AAWG, ARAC and STG adoption of the recommendations contained here in but not later than one year prior to the effective date of the rule.

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8.3 Proposed Advisory Circular Text

Advisory Circular

Subject: Repair Assessment
of Pressurized Fuselages

Date: 12/12/96 **AC No:** 121-XX
Initiated by: **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance to operators of A300, BAC 1-11, B707/720, B727, B737, B747, DC-8, DC-9/MD-80, DC-10, F28, or L-1011 airplanes operated under 14 CFR parts 91, 121, 125 and 129 of the Federal Aviation Regulations (FAR) on how to incorporate FAA-approved repair assessment guidelines into their FAA-approved maintenance or inspection program. Like all advisory circular material, this AC is not, in itself, mandatory, and does not constitute a regulation. Terms used in this AC such as "shall" and "must" are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described herein is used. While these guidelines are not mandatory, they are derived from FAA and industry experience in determining compliance with the pertinent FAR. This advisory circular does not change, create any additional, authorize changes in, or permit deviations from regulatory requirements.

2. RELATED FAR MATERIAL. The following regulations provide additional information concerning the subjects discussed herein:

- a. Sections 25.571 and 25.1529 of 14 CFR part 25.
- b. 14 CFR parts 43, 91, 121, 125, and 129.

3. RELATED GUIDANCE MATERIAL. The following documents provide additional information concerning the subjects discussed in this AC.

- a. Advisory Circular 25.571-1 B(?), dated XX/XX/XX, Damage Tolerance and Fatigue Evaluation of Structure.
- b. Advisory Circular 25.1529-1, dated 8/1/91, Instructions for Continued Airworthiness of Structural Repairs on Transport Airplanes.
- c. A Report of the Aviation Rulemaking Advisory Committee's Airworthiness Assurance Working Group entitled, "Continued Airworthiness of Structural Repairs."

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(A copy of this report may be obtained from the FAA Office of the Chief Counsel, Attn: Rules Docket (AGC-200), Docket No. XXXXXX, 800 Independence Avenue SW., Washington, D.C. 20591.

4. DISCUSSION.

a. Title 14 CFR Parts 91, 121, 125, and 129 include requirements for a structural integrity assessment of fuselage pressure boundary (fuselage fuselage skins and bulkhead webs) repairs on certain model A300, BAC 1-11, B707/720, B727, B737, B747, DC-8, DC-9/MD-80, DC-10, F28, and L-1011 transport category airplanes. These rules require the incorporation of FAA-approved repair assessment guidelines for the fuselage pressure boundary into the FAA-approved maintenance or inspection program of each operator of these airplane models.

b. The manufacturers have developed model specific repair assessment guidelines to evaluate the damage tolerance of the types of repairs expected to be found. This AC provides guidance on how those model specific repair assessment guidelines may be incorporated into an operator's maintenance or inspection program. Model specific repair assessment guidelines for the affected airplanes may be obtained from the manufacturer.

5. BACKGROUND.

a. In June 1988, the FAA sponsored a conference on aging airplanes. As a result of that conference, the Airworthiness Assurance Task Force (AATF), representing the interests of the aircraft operators and manufacturers, regulatory authorities, and other aviation representatives, was established in August 1988. The task force set forth five major elements of a program for keeping the aging fleet safe. For each airplane model in the aging transport fleet: (1) select service bulletins describing modifications and inspections necessary to maintain structural integrity; (2) develop inspection and prevention programs to address corrosion; (3) develop generic structural maintenance program guidelines for aging airplanes; (4) review and update the Supplemental Structural Inspection Documents (SSID) which describe inspection programs to detect fatigue cracking; and (5) assess damage-tolerance of structural repairs.

b. The requirements to incorporate repair assessment guidelines into the maintenance or inspection programs for certain large transport airplanes address the fifth element.

6. REPAIR ASSESSMENT PROCESS. Utilizing the repair assessment guidelines developed by the manufacturer, there are two principle techniques that can be used to accomplish the repair assessment. The first technique involves a three-stage procedure.

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This technique could be well suited for operators of small fleets. The second technique involves the incorporation of the repair assessment guidelines as part of an operator's routine maintenance program. This approach could be well suited for operators of large fleets and would evaluate repairs at predetermined planned maintenance visits as part of the maintenance program. Manufacturers and operators may develop other techniques, which would be acceptable as long as they fulfill the objectives of the rules and are FAA approved.

a. The first technique generally involves the execution of the following three stages:

(1) Stage 1: Data Collection.

(a) Older airplanes may have a great number of structural repairs. Since the records on most of these repairs are not readily available, locating the repairs necessitates a survey of the structure of each airplane. This stage specifies what structure should be assessed for repairs and collects data for further analysis. If a repair is on a structure in an area of concern, the analysis continues; otherwise, the repair does not require classification per this program.

(b) The repair assessment guidelines for each model will provide a list of structure for which repair assessments are required. Some manufacturers have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks, such as the Baseline Zonal Inspection (BZI) (typical maintenance inspection intervals assumed by the manufacturers to be performed by most operators) those details were excluded from this list.

(c) The manufacturers have developed a survey form that may be used to record key repair design features needed to accomplish a repair assessment. Airline personnel not trained as damage tolerance specialists can use the form to document the configuration of each observed repair.

(d) Repair details are collected for further analysis in Stage 2. Repairs found during data collection that do not meet the static strength requirements or are in a bad condition are immediately identified and corrective action must be taken before further flight.

(2) Stage 2: Repair Classification. Using the information from a survey form, it is possible to classify repairs into one of 3 categories:

(a) Category A: A permanent repair for which the BZI is adequate to ensure continued airworthiness (inspectability) equal to the unrepaired sur-

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rounding structure. The operator's approved maintenance or inspection program must be at least as rigorous as the BZI.

(b) Category B: A permanent repair that requires supplemental inspections to ensure continued airworthiness.

(c) Category C: A temporary repair that will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

(3) Stage 3: Determination of Structural Maintenance Requirements.

(a) The supplemental inspection and/or replacement requirements for Category 'B' and 'C' repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the manufacturer, or other values obtained using an FAA-approved method.

(b) In evaluating the first supplemental inspection, Stage 3 will define the inspection threshold in flight cycles measured from the time of repair installation. If the time of installation of the repair is unknown and the airplane has exceeded the assessment implementation times or has exceeded the time for first inspection, the first inspection should occur by the next "C check" interval or equivalent cycle limit after the repair data is gathered (Stage 1).

(c) An operator may choose to accomplish all three stages at once, or just Stage 1. In the latter case, the operator would be required to adhere to the schedule specified in the FAA-approved model specific repair assessment guidelines for completion of Stages 2 and 3.

(d) Incorporating the maintenance requirements for Category 'B' and Category 'C' repairs into an operator's individual airplane maintenance or inspection program completes the repair assessment process for the first technique.

b. The second technique would involve setting up a repair maintenance program to evaluate all fuselage pressure boundary repairs at each predetermined maintenance visit to confirm that they are permanent. This technique would require the operator to choose an inspection method and interval in accordance with the FAA-approved repair assessment guidelines. The repairs whose inspection requirements are fulfilled by the chosen inspection method and interval would be inspected in accordance with the regular FAA-approved maintenance program. Any repair that is not permanent, or whose inspection requirements are not fulfilled by the chosen inspection method and interval, would either be: (1) upgraded to allow utilization of the chosen inspection

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method and interval, or (2) individually tracked to account for the repair's unique inspection method and interval requirements. This process is then repeated at each inspection interval.

Repairs added between the predetermined maintenance visits, including interim repairs installed at remote locations, would be required either to have a threshold greater than the length of the predetermined maintenance visit or to be tracked individually to account for the repair's unique inspection method and interval requirements. This would ensure the airworthiness of the structure until the next predetermined maintenance visit, at which time the repair would be evaluated as part of the repair maintenance program.

Whichever technique is used, there may be some repairs that cannot easily be upgraded to Category 'A' for cost, downtime, or technical reasons. Such repairs will require supplemental inspections, and each operator should make provisions for this when incorporating the repair assessment guidelines into its maintenance program.

NOTE: The repair assessment guidelines provided by the manufacturer do not generally apply to repairs to structure modified by a Supplemental Type Certificate (STC). The operator, however, is still responsible for evaluating the entire fuselage pressure boundary in accordance with the program objectives. This means that the operator should develop, submit and gain FAA approval of guidelines to evaluate repairs to such structure. (See paragraph 8 of this AC).

7. IMPLEMENTATION. The means by which the repair assessment guidelines are incorporated into a certificate holders FAA-approved maintenance or inspection program is subject to approval by the certificate holders principal maintenance inspector (PMI) or other cognizant airworthiness inspector. When the PMI/cognizant airworthiness inspector having oversight responsibilities for the operator is satisfied that the operators continued airworthiness maintenance or inspection program contains all the elements of the FAA-approved manufacturer's repair assessment guidelines, the PMI/cognizant airworthiness inspector can approve an operation specification(s) or inspection program revision. However, the following guidance should be considered when implementing the program.

a. If the proposed maintenance or inspection program revises any of the FAA-approved repair assessment guidelines, the proposal must be submitted to the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.

b. Existing Repairs.

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(1) The repair assessment process should be completed in accordance with the schedule in the FAA-approved model specific repair assessment guidelines for each of the affected airplanes. Any necessary actions (revised inspection programs, etc.) to be taken as a result of the assessment would be incorporated into the FAA-approved maintenance or inspection program.

(2) Structural repairs mandated by Airworthiness Directive (AD) do not always contain instructions for future supplemental inspection requirements. If the repair assessment establishes a supplemental inspection requirement where one does not exist in the AD, the operator is not required to obtain an Alternative Means of Compliance (AMOC) to conduct those inspections. The operator would, however, be required to obtain an AMOC if the repair is modified.

c. New Repairs. Unless new repairs are accomplished according to structural repair manuals, or other equivalent method that incorporates damage tolerance methods of design and evaluation, the operator should establish a means within the maintenance or inspection program to assess new repairs using FAA-approved repair assessment guidelines. A two-stage structural evaluation and FAA approval process, described in Advisory Circular 25.1529-1, is an acceptable means of assessing the damage tolerance requirements of new repairs.

d. Reporting Requirements. There are no special reporting requirements associated with the incorporation of the repair assessment guidelines in the operator's maintenance or inspection program. The operators are, however, encouraged to report significant findings to the manufacturers in order to ensure that, if necessary, prompt fleet action be taken. Normal reporting required under 14 CFR § 121.703 would still apply.

e. Recordkeeping Requirements. Incorporation of the repair assessment guidelines does not impose any new FAA recordkeeping requirements. However, as with all maintenance, the current operating regulations (e.g., 14 CFR § 121.380) already impose recordkeeping requirements that would apply to the actions required by the rules. When incorporating the repair assessment guidelines into its approved maintenance program, each operator should address the means by which it will comply with these already established requirements. The means of compliance, along with the remainder of the program, is subject to approval by the PMI or other cognizant airworthiness inspector.

f. Implementation Time. The implementation time for assessments of existing repairs is based on the findings of repair assessment surveys and fatigue damage considerations. The implementation times for incorporation of the repair assessment guidelines into an airplane's maintenance or inspection program are specified in §§ 91.XXXX, 121.XXXX, 125.XXXX, and 129.XXXX of the FAR.

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g. Beginning of Assessment Process. After the guidelines are incorporated into the maintenance or inspection program, operators must begin the assessment process for existing fuselage repairs within the flight cycle limit specified in the FAA-approved model specific repair assessment guidelines. There are three deadlines for beginning the repair assessment process, depending on the cycle age of the airplane on [the effective date of the rule].

(1) Airplane Cycle Age Equal to or Less Than Implementation Time on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program by the flight cycle implementation time, or one year after the effective date of the rule, whichever occurs later. The assessment process would begin (e.g., accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (generally equivalent to a "D check") after the incorporation of the guidelines.

(2) Airplane Cycle Age Greater Than the Implementation Time but Less Than the Design Service Goal on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit specified in the repair assessment guidelines (generally equivalent to a "D check"), not to exceed the cycle limit computed by adding the DSG to the cycle limit equivalent of a "C check" interval (specified in the repair assessment guidelines), after incorporation of the guidelines.

(3) Airplane Cycle Age Greater Than the Design Service Goal on the Rule Effective Date. The operator must incorporate the repair assessment guidelines in its maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the next cycle limit specified in the repair assessment guidelines (equivalent to a "C check") after incorporation of the guidelines.

h. Maintenance Program Changes. When a maintenance or inspection program interval is revised, the operator must evaluate the impact of the change on the repair assessment program. If the interval escalation reduces the frequency of inspection of the affected area below the BZI, the previous classification of Category A repairs may become invalid. The operator may need to obtain approval of an alternative inspection method, upgrade the repair to allow utilization of the chosen inspection method and interval, or recategorize some repairs and establish unique supplemental inspection methods and intervals for specific repairs. Operators using the "second technique" of conducting repetitive repair assessments at predetermined maintenance visits would evaluate whether

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the change to the predetermined maintenance visit continues to fulfill the repair inspection requirements in accordance with the guidance provided in paragraph 6b of this AC.

i. Sale and Transfer of Airplanes. Before an airplane is added to an operator's operations specifications, a program for accomplishment of the repair assessment should be established in accordance with the following:

(1) For airplanes that have previously been operated under an FAA-approved maintenance program, the new operator should begin the repair assessment process in accordance with the previous operator's schedule, or with the new operators schedule, whichever would result in an earlier accomplishment date for the assessment.

(2) For airplanes that have not previously been operated under an FAA-approved maintenance program, the operator should begin the repair assessment in accordance with the deadlines specified in paragraph 7g of this AC. If the airplane design service goal and compliance times have been exceeded, the repair assessment should be accomplished prior to the airplane being added to the air carrier's operations specifications, or in accordance with a schedule approved by the PMI or other cognizant airworthiness inspector.

j. Operation of Leased Foreign Owned Airplanes. Acquisition of a leased foreign-owned airplane for use in Part 91, 121, 125, or 129 operation will require that the certificate holder determine the status of the airplane relative to the model specific implementation times. If the airplane has exceeded or is within one year of exceeding the implementation time, the certificate holder should implement the repair assessment program in the airplane's maintenance program before revenue operation. Implementation of the assessment programs then would occur per the model specific manufacturers repair assessment guidelines. Airplanes well below the implementation time would implement the assessment program by the time the airplane reached the model specific implementation time.

8. REPAIRS TO STRUCTURAL MODIFICATIONS CERTIFIED BY A SUPPLEMENTAL TYPE CERTIFICATE (STC).

a. The operator will need to establish a program for repair of structure modified by an STC. Those repairs that can be evaluated using the manufacturer's model specific repair assessment guidelines should be documented and submitted to the operator's PMI/cognizant airworthiness inspector for approval. The PMI/cognizant airworthiness inspector may approve the program subject to the guidance in paragraph 7 of this AC. For all other repairs, a separate program will need to be developed.

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b. It is recognized that the operators do not usually have the resources to determine a DSG or to develop repair assessment guidelines for structure approved under STCs. The operator may need to seek help in showing compliance, and this help would normally be provided by the STC holder. In the event that the STC holder is unable to provide this assistance and the repair is of a size or type that excludes it from being treated like a repair in the manufacturer's SRM, model specific documents, or other approved source, the operator may have to hire the necessary expertise to develop and gain approval of repair assessment guidelines and the associated DSG.

c. The cost and difficulty of developing guidelines for modified structure may be less than that for the basic airplane structure for three reasons. First, the only modifications made by persons other than the manufacturer that are of concern are those that affect the fuselage pressure boundary. Of those that do affect this structure, many are small enough to qualify as Category "A" repairs under the repair assessment guidelines, based solely on their size. Second, if the modified structure is identical, or very similar, to the manufacturer's original structure, then repairs made to the structure modified by an STC are probably covered by referencing the manufacturer's guidelines and the SRM. Third, the modification may have been made so recently that no repair assessment guidelines would be needed for many years. Compliance with the rules could be shown by establishing the DSG for the new modified structure, calculating an implementation time that is equal to three quarters of that DSG, and then adding a statement to the operations specifications that repair assessment guidelines would be incorporated into the maintenance program by that time. No guidelines would be needed until 75 percent of the new DSG is reached.

9. ALTERNATE METHODS. As specified previously, this AC provides a means of compliance with the rules. If an operator wishes to develop its own repair assessment guidelines and submit such guidelines for FAA approval, it may do so. The proposed repair assessment guidelines must ascertain the "damage-tolerance" of the repairs to the extent necessary to establish what supplemental maintenance actions, if any, are necessary to assure that fatigue damage will be detected before the damage degrades the load carrying capability of the structure below certification levels. The proposed guidelines should be submitted jointly to the operator's PMI/cognizant airworthiness inspector and the FAA Aircraft Certification Office (ACO) having cognizance over the type certificate for the affected airplane.